Annual progress report for: **Global MHD Simulation of Mesoscale Structures at the Magnetospheric Boundary**

Principal Investigator: **Jean Berchem**
Institute of Geophysics and Planetary Physics
University of California Los Angeles
Los Angeles, California 90095-1567

Tel : (310) 206-2849
Fax: (310) 206-3051
E-mail: jberchem@igpp.ucla.edu

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**Progress Summary**

Steady solar wind conditions

We have started our research effort by carrying out a series of 3 D global magnetohydrodynamics (MHD) simulations of the solar wind/magnetosphere interaction using a set of predetermined solar wind parameters to model steady solar wind conditions.

Three regimes of constant dynamic pressure were used for the solar wind input to the 3D global MHD code:

| regime | density (cm-3) | velocity (km/s) | thermal pressure (pPa) |
|---|---|---|---|
| low: | 5 | 300 | 3.45 |
| medium: | 7.3 | 420 | 5.04 |
| high: | 10 | 650 | 13.81 |

For each of these three regimes we simulated three periods of 40 minutes using different directions of the interplanetary magnetic field (IMF):

| | | | |
|---|---|---|---|
| south : | Bx=0 nT | By=0 nT | Bz=-5 nT |
| dusk: | Bx=0 nT | By=5 nT | Bz=0 nT |
| north: | Bx=0 nT | By=0 nT | Bz=5nT |

In addition, the nine sets of steady solar wind conditions defined above were run for two different values of the Earth's tilt angle to obtain magnetospheric configurations for minimum (0°) and maximum (≈34°) inclinations of the magnetic dipole. The size of the data set generated from these 18 cases is about 6 GB and has been archived on CD-ROM.

We are currently in the process of analyzing the results of these runs to investigate geometrical properties and the topology of the magnetic and electric fields for the different solar wind regimes considered. In particular, we have focused on the displacement of the cusp region of the magnetospheric boundary to establish its location

as a function of the solar wind dynamic pressure, IMF direction and magnetic field dipole tilt [Berchem et al., 1995a].

Multispacecraft-simulation intercomparisons

Running a large number of simulations to accumulate enough data for carrying out significant statistical studies is a slow process. We thus decided to proceed and started working on multispacecraft intercomparison studies which we originally planned to conduct later in the course of the investigation. This decision was also prompted by the upcoming availability of the data from the WIND spacecraft at the sunward Lagrangian point (L1). Correlation between WIND data and measurements from the GEOTAIL and IMP 8 spacecraft will provide invaluable observational support for our study of the mesoscale structures at the magnetospheric boundary.

In anticipation of the WIND data availability, we simulated the interaction of an interplanetary shock with Earth's magnetosphere that occurred on August 27, 1978. This event was first observed by ISEE 3 at L1 and about 25 minutes later by ISEE 1 and 2, located at about 10 $R_E$ in the subsolar region. The ISEE 1 and 2 spacecraft measured a strong compression pulse followed by a very rapid earthward motion ($\approx$ 200 km/s) of the magnetopause. Using the plasma parameters and magnetic field measured by ISEE 3 as input to our high resolution global MHD code, we investigated the response of the magnetospheric boundary to the disturbance. Comparison of the ISEE 1 and 2 measurements with simulated time series at the spacecraft locations revealed excellent agreement between the simulation results and the observations. This agreement provided the basis for the investigation of the mesoscale structure of the boundary before and after the interaction, as well as the global geometry and dynamics of the magnetospheric boundary during the event. In particular the simulation was able to show that the short incursion into the solar wind observed by one of the spacecraft (ISEE-2) during the event resulted from a change in the global curvature of the magnetopause rather than a change in the local topology of the boundary. These results were reported at the AGU spring meeting [Berchem et al., 1995c] and the IUGG Meeting in Boulder, Colorado [Berchem et al., 1995b]. We have begun writing up these results, and the manuscript should be ready for submission to JGR before May 96.

More recently we started new correlative studies using the GEOTAIL and WIND spacecraft. These studies stem from our participation at the WIND/GEOTAIL Correlative Studies Workshop held May 16-18, 1995 in Honolulu and December 16-17, 1995 in Berkeley. During these meetings three time intervals where chosen during which the GEOTAIL spacecraft was skimming the dayside magnetopause and WIND and/or IMP-8 were monitoring the solar wind conditions. These time periods are very rich in events for both northward and southward IMF conditions. We have started simulating these events using WIND data. Although simulating such skimming events is difficult, preliminary results are encouraging. We have accepted an invitation to present these results at the Spring AGU Meeting [Berchem et al., 1996].

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## References

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